DOCUMENT RESUME

ED 409 858 IR 018 447

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TITLE Instructional Technology Benchmarks for Teacher Preparation Programs and K-12 School Districts.
PUB DATE 97
NOTE 9p.; In: Proceedings of Selected Research and Development Presentations at the 1997 National Convention of the Association for Educational Communications and Technology (19th, Albuquerque, NM, February 14-18, 1997); see IR 018 421.
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Literacy; Educational Development; Educational Equipment; *Educational Needs; *Educational Technology; Elementary Secondary Education; Guidelines; Higher Education; Mentors; Modeling (Psychology); Needs Assessment; Outreach Programs; *Professional Development; Program Development; *Teacher Education
IDENTIFIERS *Benchmarking; Competency Needs; Florida; *Training Needs

ABSTRACT

The purpose of this study was to establish guidelines for the instructional technology elements of preservice and inservice teacher preparation programs as well as standard technological competencies for their K-12 students. To establish benchmarks reflecting preservice and inservice training needs, four analysis approaches were conducted, and data were triangulated using a qualitative pattern-matching approach. Analyses included: (1) a critical review of prominent guidelines (both national and for the state of Florida); (2) key informant meetings conducted with educators from surrounding school districts; (3) an instructional technology teacher preparation survey; and (4) a review of instructional technology literature to establish current trends in instructional technology uses in public education. The analysis revealed that the following areas were critical for preparing preservice and inservice teachers to become leaders in instructional technology: state-of-the-art laboratories; preservice teacher preparation; graduate-level preparation; higher education faculty or teacher peers as models; and inservice and outreach. Benchmarks were established for all five areas and are currently being used at the University of West Florida in: preservice teacher training, a graduate program in instructional technology, faculty development, outreach, and upgrading equipment for the laboratories. Effecting change in preservice teacher preparation and in K-12 education requires a set of clearly defined systemic benchmarks as provided through this study. (Contains 14 references.) (AEF)

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ED 409 858

Instructional Technology Benchmarks for Teacher Preparation Programs and K-12 School Districts

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Introduction

During the past ten years, between 300,000 and 400,000 computers have been added annually to school inventories across the United States. An estimated 6 million computers are now in K-12 schools, with the number of computer purchases expected to increase annually during the next decade. Currently, seventy-five percent of all schools have access to telecommunications through local or wide-area networks; 35% have direct access to the Internet (U.S. Congress, 1995). Yet, neither teaching nor learning with technology is widespread (NEA, 1993; SERVE, 1993).

As a result of inadequate preservice (Beaver, 1990; Brooks & Kopp, 1989) and inservice training (Shaw, 1995), teachers are not being prepared to use technology. Researchers concluded that teachers are being inadequately prepared to use instructional technology, and consequently are unable to effectively integrate technology into classroom teaching practices (U.S. Congress, 1995).

Preservice Teacher Preparation

Currently, fewer than 40% of colleges, schools, and departments of education nationally require a single course in instructional technology with only 18 states requiring technology training for all teachers seeking certification (Anderson, 1994). For those colleges, departments, and schools of education requiring at least one course in instructional technology, many barriers exist. Lack of equipment, current software, and ongoing budgets for maintenance and upgrades continue to be problematic (Northrup & Little, 1996). Some argue that teaching a single course in instructional technology may not be the right approach (Roblyer, 1994). Many times a single survey course will focus on equipment and software use without making connections to curriculum integration. Few colleges and schools of education are beginning to integrate instructional technology applications within methods courses (White, 1991) in lieu of a survey course. Theoretically, this approach will model the integration and use of instructional technology within specific subject areas and grade levels. Regrettably, many methods faculty do not have the range of skills required nor the time in a single semester to teach students the hardware and software basics along with the conceptual understanding of how technology can be integrated. White (1991) proposes a three step model for technology teacher preparation: (1) Train teachers on what the computer (technology) can do; (2) Train teachers what learners can do with technology; and (3) Emphasize the new role of the teacher (in a technology-rich environment).

K-12 Teacher Inservice Training

School districts continue to struggle with *technology inservice training* for teachers. Parker (1991) indicates that both new and veteran teachers require the same amount of instructional technology training; college and schools of education are not preparing teachers to use technology in the classroom. Most teachers agree, with 59% of those surveyed reporting that their training was inadequate to prepare them to use successfully technology in the classroom (SERVE, 1993). In a 1988 study conducted by the Office of Technology Assessment, only one-third of K-12 teachers have had 10 or more hours of computer training. A 1996 study suggests that not much has changed with 36% receiving up to 10 hours of computer training (Northrup, Shaw, & Rasmussen, in press). Staff development research on instructional technology suggests that teachers should be trained to use technology in a hands-on setting with curriculum specific applications. Following should be ongoing support (U.S. Congress, 1994). Glenn and Carrier (1989) propose three steps to effective inservice technology training: (1) propose examples of how effective teachers use technology; (2) be aware of significant anxiety concerns of teachers; and (3) assign peer teachers and model effective uses of technology at the school site.

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Instructional Technology Guidelines

National and state instructional technology guidelines are beginning to emerge that identify competencies required for graduates of preservice programs, for practicing teachers, and for students. At the national level, the International Society for Technology in Education (ISTE) has developed *Curriculum Guidelines for Accreditation of Educational Computing and Technology Programs* which have been adopted by NCATE as the instructional technology guidelines for teacher preparation programs. In addition, NCATE has standards in other areas reflecting exemplary technology use in all areas of the unit. For example, under the qualifications for professional education faculty, faculty must model the integration of computers and technology in their fields of specialization. With 18 states requiring instructional technology training in colleges and departments of education, specific state requirements have been identified. In Florida, the Preprofessional Accomplished Practices and the Accomplished Practices for Technology for Technology serve as the accountability measure for technological competence at the end of a teacher preparation program (Preprofessional Accomplished Practices) and again at the fifth year of teaching (Accomplished Practices). Both serve as benchmarks for teacher performance.

In Florida, some school districts are preparing for the implementation of Florida's Sunshine State Standards (1996) by training teachers on the standards/benchmarks set for students by grade level cluster (P-2; 3-5; 6-8; and 9-12) and by subject. One mid-sized district in Northwest Florida is establishing staff development competencies for instructional technology based completely on the competencies identified for students in Florida's Sunshine State Standards.

"K-12 schools and preservice teacher education programs must make significant investments in faculty development to realize the full potential of technology. A need exists to identify specific benchmarks defining what preservice and practicing teachers should know and be able to do and how technology should be infused into the preparation of preservice teachers. Given the critical role of technology in K-12 education and the social and economic future of the nation, preparing teachers to effectively use instructional technology in the classroom is critical" (Northrup & Little, 1996, p. 213). The purpose of this study is to establish instructional technology benchmarks for K-12 and teacher preparation programs in colleges, departments, and schools of education.

Method

To establish benchmarks for teacher preparation programs and for K-12 schools reflecting the preservice and inservice training needs, four analysis approaches were conducted and data were triangulated using a qualitative pattern-matching approach. The analyses included: (a) a critical review of prominent guidelines [both National and State] (b) a key informant study; (c) an instructional technology survey; and (d) a review of instructional technology literature.

Guidelines reviewed include: (a) The National Council for the Accreditation of Teacher Education; (b) International Society for Technology in Education's Educational Computing guidelines; (c) Florida's Sunshine State Standards; and (e) Florida's Accomplished Practices for Instructional Technology. The guidelines were synthesized into a usable matrix to identify commonalities. The guidelines were then clustered by topical area (computer basics, telecommunications, integration, instructional design, etc.) and by order of presentation.

Key Informant Meetings were conducted with educators from the surrounding school districts, a medium and a small district. The key informant meetings were composed of teachers representing all grades, school-based media specialists, special education educators, school-based administrators, district-level administrators, and the Director of Technology for each district. In each key informant meeting, participants were asked to respond to several questions regarding their level of instructional technology use in the school and district, the projected use in the future, and their concepts of what the university should do to prepare preservice and inservice teachers for the integration and use of instructional technology.

Instructional Technology Teacher Preparation Survey. A 25-item survey was administered to 300 K-12 teachers and administrators in the surrounding school districts to further reinforce the outcome of the key informant meetings. Educators responded to specific areas of instructional technology use and indicated which technologies must be taught in preservice teacher preparation programs. Additional demographic information was collected to include: grade level/subject taught; number of computers in the classroom; number of computers available in the lab; numbers of inservice hours attended; and percentage of time engaged in technology use for both administrative and classroom use.

Review of the Literature. A critical review of the instructional technology literature was conducted to establish current trends in instructional technology and uses in public education.

Results

Data were analyzed using a qualitative approach clustering key concepts into categories through a pattern matching approach. Five critical areas emerged with each category in this sytem representing key issues for K-12 and teacher preparation: (1) State-of-the-Art Laboratories, (2) Preservice Teacher Preparation, (3) Graduate-level Preparation, (4) Higher Education Faculty or Teacher Peers as Models; and (5) Inservice and Outreach. The analysis revealed that all areas were critical for preparing preservice and inservice teachers to become leaders in instructional technology. Benchmarks were established for all five areas. Currently, the benchmarks are being used at the University of West Florida in preservice teacher training, in a graduate program in instructional technology, in faculty development, in outreach, and in upgrading equipment for the laboratories.

State-of-the-Art Laboratories

Laboratories were directly addressed in the NCATE Standards and in the key informant meetings. Technology-using K-12 teachers provided examples of their classroom and school infrastructure which included 3-6 networked computers per classroom; networked computer labs; and ITV production studios. Teachers indicated that they would be unable to integrate technology effectively without the use of computers that could run current versions of software required. Additionally, in key informant meetings, school administrators suggested that the purchase of new computers must be driven by a set district standards for new equipment acquisition. In a review of the research, industry standards adopted by software developers such as IBM's Educational Software Division (formerly EduQuest) and Microsoft set a target for software development, based on the current industry standard. Finally, the Secretary's Commission on Achieving Necessary Skills (SCANS) competencies should be a consideration in any state-of-the-art laboratory facility. According to SCANS, students are not being prepared to enter the workforce. Student exposure to instructional technology ranges from 25 minutes to 1 hour per week. The exposure to a variety of platforms and experiences is directly related to the level of comfort a teacher has with technology. Laboratories should maintain multiple platforms and peripherals.

Benchmark: State-of-the-Art Laboratories

- "Multiple platforms should exist including Macintosh and IBM. (Power Macintoshes may be most appropriate).
- Adhere to the current industry standard as closely as possible. For example, if software is no longer available for System 6.07 for the Macintosh and all software of interest requires a minimum of 8 mb of RAM, do not purchase a Macintosh Plus.
- A minimal number of Apples (Apple IIe or IIgs) should be maintained as many schools are still operating with this configuration.
- One or more multimedia development stations with memory and hard disk capability to capture and playback video and sounds should be provided.
- Several stations with connectivity to the Internet, preferably graphic-based browser software such as NetScape should be available for student and faculty research.
- Modems should be no less than 28.8 bps.
- Point-to-point and multi-point desktop videoconferencing should be accessible to students through the LAN and to the region via a MAN or WAN.
- CD-ROM at a minimum of 4X should be included on any new purchase or donation.
- Current software titles for productivity tools, integrated software, desktop publishing and graphics should be maintained.
- Authoring tools that parallel the needs of the region should be maintained. Multi-platform authoring tools are preferred.
- Laboratory security should be maintained on all stations through lock-downs, student passwords, and limited access to files." (Northrup & Little, 1986, p 217)

Preservice Teacher Preparation

Data from the ISTE Guidelines, Florida's Preprofessional Accomplished Practices for Technology, and results from the Key Informant Meeting were clustered by category. The national and state guidelines suggested the following categories: (a) computer basics; (b) connecting peripheral devices; (c) productivity for administrative use;

(d) productivity for classroom use; (e) integration of technology; (f) multimedia authoring and presentation tools; (g) telecommunications tools; (h) instructional design; (i) software selection and evaluation; (j) copyright, ethics, and equity; and (k) locating journals and more information on instructional technology. In addition, the Technology Teacher Preparation survey disseminated regionally to 300 K-12 teachers, indicated that word processing was the most needed skill to be taught in preservice instructional technology courses with 72% of the teachers surveyed responding that above average to extensive preparation must occur prior to entering the classroom. Other skills reported by practicing teachers include: productivity tools, multimedia tools, predeveloped software; and the Internet. The most critically rated productivity tools include: graphics programs (48%); desktop publishing (46%); spreadsheets (41%); and databases (40%). Multimedia tools include CD-ROM (46%) and laserdisc (45%). Predeveloped instructional software preparation includes drill and practice (42%); problem solving software (46%); tutorials (40%); and simulations (37%). The following benchmarks for teacher preparation reflect the knowledge, skills, and abilities of a graduate of a teacher preparation program. See Table 1 for a complete description of suggested technological skills that preservice teachers should attain as reported by veteran teachers.

Table 1. Teacher Perception of Instructional Technology Preparation in Preservice Teacher Education Programs

Technology	Above Avg Prep	Extensive Prep	Total Prep
Word Processing	37	34.6	71.6
Graphics	32.1	16	48.1
Problem Solving	25.9	19.8	45.7
CD-ROM	29.6	16	45.6
Desktop Publishing	25.9	19	44.9
Laserdisc	34.6	9.9	44.5
Drill & Practice	25.9	16	41.9
Tutorials	23.5	17.3	40.8
Spreadsheets	27.2	13.6	40.8
Database	28.4	11.1	39.5
Simulations	22.2	14.8	37
Research/Internet	25.9	11.1	37
TV/classroom use	21	13.6	34.6
Authoring	28.4	6.2	34.6
E-mail	22.2	11.1	33.3
Downloading Files	21.3	10	31.3
Uploading Files	21	9.9	30.9
Scanning	21	2.5	23.5
Using newsgroups	18.5	4.9	23.4
Photo CD	19.8	2.5	22.3
Digital Video	17.3	3.7	21
Network Setup	12.3	8.6	20.9
Digital Camera	17.3	2.5	19.8
Network Maintenance	13.6	4.9	18.5
Audio CD	16	2.5	18.5

Note: Perceentage of Above Average and Extensive Preparation included.
N=87

Benchmark: Preservice Teacher Preparation

- "Operate a microcomputer system to include powering-up the computer, installing programs, accessing programs in other drives (such as CD-ROM in drive d:/), saving files to diskette, and deleting files within the context of a Macintosh, Windows, and DOS-based system. (*)

- Set up and operate peripherals such as scanners, laserdisc players, CD-ROM, modems, and printers. (*)
- Use productivity software to include word processors, spreadsheets, databases, desktop publishing and graphics to perform basic administrative tasks such as mail merge, grading, and creating basic newsletters. (*)
- Integrate productivity software including word processors, spreadsheets, databases, desktop publishing and graphics into a classroom curriculum assignment. Examples may include using databases to gather and store information on hurricanes, spreadsheets to record daily temperatures across the country and predict weather patterns, and desktop publishing/graphics to publish a paper on the temperature highs and lows across the southeast.
- Use presentation software to present group integration projects. (*)
- Set up a telecommunication station by installing communication software and by configuring the modem to appropriate settings. (*)
- Use telecommunication to send and receive e-mail and to access network resources through World Wide Web, gopher, telnet, or ftp. (*)
- Integrate telecommunication including electronic communication and information access into a classroom curriculum assignment. Examples may include following the migration of whales on WhaleNet, tracking the shuttle mission on NASA Spacelink, or tracking the dog sled races to the North Pole.
- Use multimedia authoring tools to create instructional lessons. (*)
- Use multimedia CD-ROM, laserdisc, and digital photography to access and store information. (*)
- Integrate multimedia including authoring tools, CD-ROM, laserdisc, and digital photography into a classroom curriculum assignment. Examples may include creating a multimedia-authored lesson on the migration of whales using laserdisc, CD-ROM, and digital photography.
- Apply principles of instructional design to evaluate and select software appropriate to a given grade level, subject, or varying exceptionality.
- Promote ethical and legal behavior in the use of instructional technology for school and home use." (Northrup & Little, 1996, p 218)

Graduate Level Preparation

Data for this section were gathered from the ISTE Guidelines for Graduate Programs in Instructional Technology and recent research in the field. Students interested in receiving graduate degrees in instructional technology must be trained as decision-makers in the field and must gain advanced knowledge, skill, and ability in the design, development, and application of emerging technologies for teaching and learning (Northrup & Little, 1996). The following are benchmarks established for graduate level instructional technology preparation.

Benchmark: Graduate-level Preparation

- "Meet all basic hardware knowledge and use requirements specified in the undergraduate benchmarks (denoted by an *).
- Apply technology tools to solve a variety of problems for teaching and learning with technology.
- Make decisions regarding the use of specific technologies based on empirical research on learning effectiveness.
- Create a technology plan based on a defined critical need in search of a resolution.
- Synthesize available research on instructional design and current theories of learning to create instructional courseware using a selected authoring tool.
- Synthesize available research on instructional design and current theories of learning to create multimedia and hypermedia products using authoring tools, video clips, sound, animation, and hypertext links.
- Synthesize available research on instructional design and current theories of learning to create telecommunication simulations and active environments for learning by using available telecommunication resources on the Internet.

- Synthesize available research on instructional design and current theories of learning to design and deliver instruction using distance education.
- Analyze critically the ethics and equity of technology in K-12, higher education, industry, and for home use.
- Develop a comprehensive plan for managing a large-scale instructional technology system.
- Conduct research on the effectiveness of instructional technology on specified variables of interest for learning, motivation, and/or learning strategies to further the field of instructional technology." (Northrup & Little, 1996, p. 219)

Teacher Educator Models

According to Brooks & Kopp (1989), building strong faculty models of instructional technology utilization in the classroom is critical to the success of entire programs. A review of the literature has revealed that most faculty who do not integrate technology into their teaching practice report lack of access, lack of time, and lack of support as the most critical reasons. Additional data sources for the establishment of benchmarks in the area of faculty modeling includes NCATE standards, specifically that faculty must model the integration of computers and technology in their fields of specialization. Specific benchmarks were established for this area based on NCATE and a review of instructional technology standards required by K-12 students through Florida's Sunshine State Standards, as our faculty are encouraged to model and teach based on Florida's Sunshine State Standards. The following benchmarks are designed as a model for training faculty to integrate instructional technology into their classroom teaching experiences:

Benchmark: Teacher Educator Models

- "Master basic instructional technology skills in the area of productivity, multimedia, telecommunication, and classroom integration.
- Use presentation and multimedia software as a medium for the delivery of class lectures.
- Use presentation and multimedia software to deliver speeches, lectures, and seminars at professional conferences.
- Require students to word process all final work for course assignments.
- Require students to work collaboratively to make group presentations using technology.
- Model and require students to use technology for problem-solving tasks using telecommunication, CD-ROM, and laserdiscs to access and apply information, databases for information storage and retrieval, and spreadsheets for prediction and hypothesis testing.
- Use computer-assisted instruction as an alternative instructional delivery medium.
- Use teacher utility tools for grading, recordkeeping, and test generation.
- Introduce new software in content-related courses relevant to teaching and learning specific topic areas such as Language Arts, Mathematics, etc." (Northrup & Little, 1986, p 220)

Inservice

SERVE (1993) reports that inservice is the most important approach for teachers to become technologically literate and to receive current information. However, many current inservice initiatives are not outcome-driven and are not expected to produce measurable results after training has been received. To establish benchmarks for inservice and outreach, data were clustered in two ways: (1) by topic area for inservice and (2) the responsibilities of the higher education institution in providing inservice to veteran teachers. The first cluster, topic area, was defined by the aggregation of the ISTE guidelines, Accomplished Practices for Instructional Technology, and Florida's Sunshine State Standards. The results parallel the findings of the preservice teacher preparation benchmarks. The teacher preparation benchmarks have actually been adopted by school districts as their plan for inservice activity.

The second cluster, how higher education institutions can facilitate inservice activities is a result of data gathered through key informant surveys. The results are as follows:

Benchmark: Inservice and Outreach

- "Provide several opportunities per year for teachers to attend short courses and workshops using instructional technology faculty (after school, weekends, and during the summer).

- Provide a mechanism for ongoing support after teachers attend workshops, courses, etc.
- Promote at least one event annually bringing teachers, administrators, and teacher preparation faculty together to learn more about instructional technology.
- Collaborate with area school districts on the direction and use of instructional technology through Technology Planning.
- Visit area schools to maintain visibility and to learn new ways technology is being used in the classroom.
- Serve on school- and district-level instructional technology focused committees.
- Collaborate with industry, hardware vendors, and software vendors to maintain current knowledge of regional and national developments in the field.
- Create an informational newsletter and/or an Internet home page for practicing teachers to keep abreast of teacher education technology events." (Northrup & Little, 1986, p 221)

Conclusion

Effecting change in preservice teacher preparation and in K-12 education requires a set of clearly defined systemic benchmarks as provided through this study. Implementation of this systemic approach in teacher preparation programs will prepare preservice teachers for classroom teaching in the 21st Century. Used in K-12 schools, this approach will assist in developing veteran teachers knowledge, skill, and ability in instructional technology while looking at the entire system of adequate laboratory space, continued inservice, and modeling of instructional technology for peers and for teachers. The implications from this study are primarily that instructional technology change will not occur unless key elements of the system are addressed. The benchmarks specified in this study can serve as a guide to teacher preparation programs and K-12 school districts wishing to facilitate this change.

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